THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 202.

THE PATENTS FOR INVENTIONS BILL.

ALTHOUGH Mr. Anderson's Bill for amending the existing law relating to Patents has been read a second time, it seems to be certain that it will not become law during the present session; the matter however cannot long remain unsettled, as the pressure which has been brought to bear is not likely to be diminished. In the debate which followed Mr. Anderson's motion there was a very general concurrence of opinion that the laws required alteration, though what the alteration should be was practically left an open question. To reduce the fees and to lengthen the period during which a patent is good, are of course the two main elements required, and in these two respects England stands at a great disadvantage as compared with America, and indeed with European countries. The fact that charges to patentees in Germany, France, Austria, and Belgium, are less than in England, might however be taken as an argument against the proposed reduction of the fees, for we are not aware that invention in the countries mentioned is so remarkably ahead of our own country; this fact appears to have been quite overlooked, as it was with America, and America only, that comparisons were made in the debate. It appears that the cost of a patent in America is 35 dollars for 17 years' protection, and in this country the cost is as much as 875 dollars for 14 years, so that we are charged 25 times as much as the Americans for a less valuable privilege. The United States Government does not seek to make a profit out of patents, but only to pay the expenses of the Patent Office. Their more liberal system, however, under which 15,000 patents were taken out in a year, as against 3,300 in Great Britain, pays so well as to leave a considerable surplus to the credit of the Patent Office, and the Government is considering the reduction of the charge of £7 to a still lower figure.

One of the most beneficial improvements suggested by Mr. Anderson is the proposal to extend the term of the provisional patent from six months to twelve; the former period is certainly, in the majority of cases, barely sufficient to enable an inventor to place his invention in the market. But it is doubtful whether it is advisable to divide the term during which a patent may be made good into various periods. Mr. Anderson, in making suggestions for changing the existing state of affairs, brought forward no argument to prove that it was desirable to retain the present system of dividing the full term into periods, nor in the debate was anything said either for or against the arrangement. If the reform is undertaken, it is to be hoped that as simple and cheap a system as that adopted in America will be framed, and there is, we think, little likelihood that such a system will require an increase in taxation to enable the Patent Office to carry on the necessary work.

FULLER'S IMPROVED MIRROR SIGNALLING GALVANOMETER.

THE object of this arrangement, the invention of Mr. J. W. Fuller, is to obtain a clearer definition of signals on the mirror instrument than is possible with the existing apparatus, and at the same time to make these signals as rapid and distinct as possible, so as to obtain a high speed of working. In order to effect these results, the bobbin on which the insulated wire is wound is constructed of a peculiar shape, the opening or passage throughout its centre being of various dimensions, diminishing as it approaches the part to be occupied by the mirror; the consequence is that the conducting wire when wound upon it is at different distances from the centre, according to the position in which it surrounds the before-mentioned opening.

At the end of the central opening or passage in the bobbin a special contrivance is inserted for holding the suspended mirror, consisting of a semi-funnel-shaped tube or cup, and made so as to suit whatever range of reflected light may be required upon the scale.

Fig. 1 is a transverse section of the bobbin and coils of the improved instrument. It is wound in four sections, *a*, *b*, *c*, and *d*. The front coil, section *a*, *w*, *a*, has an opening in the centre of a size only sufficient to receive the holder, in which the suspended mirror and magnet are contained. This holder is shown by the fig. 2, the mirror and magnet being arranged and suspended in the usual manner. The part of the holder in which the mirror and magnet are held suspended is of cylindrical form, and from this two wings project obliquely to the front, giving to the holder a semi-funnel-like form. These wings, which from their obliquity do not obscure the light from the mirror whilst it moves through a sufficiently large angle, render it easy to change the suspended magnet and mirror at any time when it may become desirable. The holder being taken hold of by its wings can be drawn out from its place in the centre of the part *a* of the coils, and put back in an instant.

The section, *b*, of the coils immediately behind the section, *a*, has an aperture through it larger than the aperture in the coil, *a*; and in the sections, *c* and *d*, the apertures are again and again larger. Thus there is a coniform cavity within the series of coils, and in this cavity are arranged adjusting appliances.

m represents the ordinary directing magnet above.

Fig. 3 shows a transverse section of the coils of the instrument, and with it one of the adjusting appliances. The latter consists of two straight

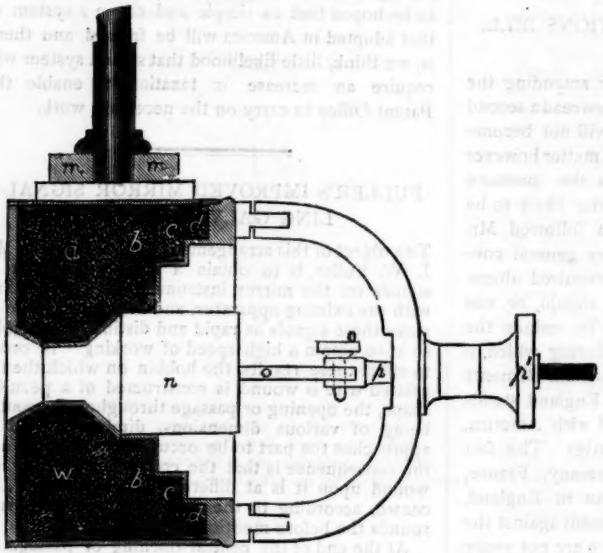


FIG. 1.

In making the adjustment these rods can be independently pushed inwards and drawn outwards with the fingers. They can also be moved together nearer to or further from the suspended mirror, for they are carried in a holder, *n*, which is coupled by

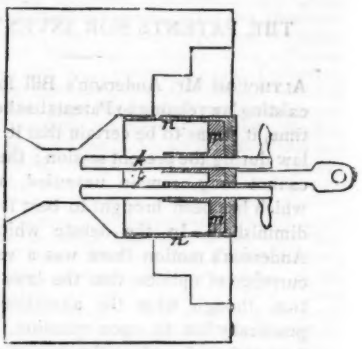


FIG. 3.

FIG. 2.

magnetic rods, *k* and *l*, joined across, the north pole of one to the south pole of the other, by the iron connecting piece, *m*; there are sockets on the connecting piece through which the magnetic rods, *k* and *l*, can slide.

the pin, *o*, with the slide, *p* (fig. 1). This slide has a screw cut upon its stem which passes through the thumb nut, p_1, and by turning this nut the slide, *p*, is moved to or from the coils carrying the adjusting appliance with it.

NEW ELECTRIC LAMPS.

THE GRAMME ARC LAMP.

By HYPPOLYTE FONTAINE.

AFTER three months of experiments with a score of lamps, we have come to the conclusion that the last idea of M. Gramme has solved completely the problem of fixity in powerful electric lamps.

The Gramme regulator, represented in elevation by the figure, is arranged to show in the same plan the important parts of the mechanism.

In this apparatus the lower carbon holder is fixed, the upper one is movable. These conditions are not indispensable. M. Gramme makes regulators with the luminous point fixed, placed in position without any screen, and arranged to throw all their light on the ceiling, &c. All the special forms possess the same essential parts in the mechanism, viz., a very powerful motor, an intermittent electro-magnet, a withdrawing movement distinct from the approaching movement, a carbon holder with an eccentric spring.

The mechanism is contained in a cylindrical case fixed to two end discs solidly connected together by tie rods.

This mechanism is formed of two completely distinct parts, of which the one assures the progressive advancement of the carbons, and the other the recession for the formation of the voltaic arc.

The upper electro-magnet is attached to the tie pieces; its armature, C, is fixed to the upper part of the rods, E, E, which traverse the whole length of the

regulator, and are prolonged so as to form the lower carbon holder, G. Two springs, R, R, force the armature, C, away from the poles of the electro-magnet when no current is passing.

The current arrives by the positive terminal, which is in communication with the whole of the regulator; it passes by the positive central rod, D, through the upper carbon, the voltaic arc, the lower carbon, the negative rods, E, E, the electro-magnet, A, A, and leaves by the negative terminal, which is insulated.

What I am about to describe constitutes the retrograde movement for the formation of the arc. This movement is not only independent of the gearing mechanism, but it is also removed as far as possible from these. The inventor avoids thus the accidental influence which might take place between the two magnets.

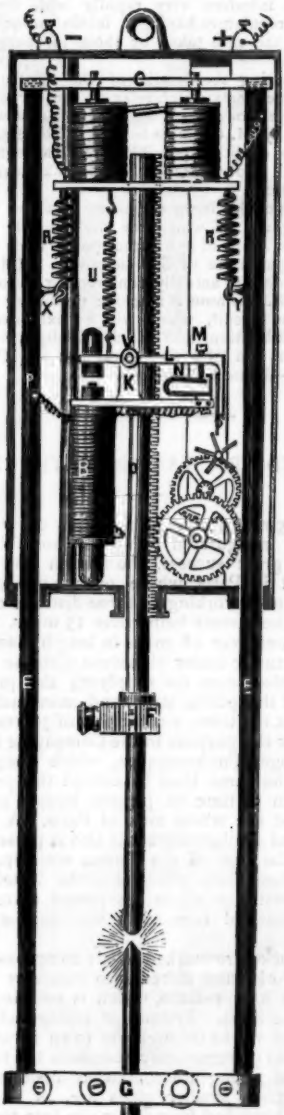
The positive rod, D, is very heavy; it is formed with a rack on one side, and carries at its extremity the upper carbon, F.

An electro-magnet, B, wound with a wire of high resistance, is fixed to the ties of the regulator. This electro-magnet carries a jointed piece, K, on which a lever, L, is hinged. This last is maintained in a horizontal position by the spring, U. The armature, I, of the electro-magnet, B, is fixed to the lever, L. A screw, M, and a little plate, S, are placed at the other extremity of the same lever. The mechanism is completed by a spring, N, insulated from the rest of the apparatus and placed on the piece, K, with a piece of hard rubber between.

The current which traverses the electro-magnet, B, comes from P through one of the negative rods, then, by means of a screw in communication with the spring, N, it passes through the latter to the screw, M, and the lever, L. So long as the main current preserves a certain intensity—that is to say, so long as the voltaic arc does not become too long—the plate, S, locks the clockwork movement, and prevents the positive rod from descending. But at the moment when equilibrium is destroyed, the power of the electro-magnet, B, increases, the armature, I, is attracted, the lever oscillates, and the plate, S, becomes raised and allows the wheelwork and, consequently, the rod, D, to descend. The carbons approach and the arc becomes diminished in length. The screw, M, then leaves the spring, N, and the current ceases to traverse the electro-magnet, B. The armature, I, pulled by the spring, U, regains its horizontal position; the contact of the screw, M, with the spring, N, again takes place. And if the arc is not rigorously at its normal length, the same movement recommences until this result is obtained. The intermittence in the action of the electro-magnet, B, has a chief advantage in suppressing the variations of the light which is observable in all the other kinds of regulators.

This advantage is easy to explain. In all the regulators with a powerful motor the movement of approach of the carbons is obtained by the aid of an electro-magnet and a powerful antagonistic spring. When the influence of the electro-magnet makes itself felt—that is to say, when the armature is attracted—the distance between the poles and the armature becomes diminished, the equilibrium between the tension of the antagonistic spring and that of the electro-magnet becomes broken during a certain period. The carbons approach a little more than they ought and cause the arc to become too short before the wheelwork becomes locked. The variations of the arc take place naturally with the variations of the intensity of the current and the luminous arc changes correspondingly, as is so well known.

With an intermittent action of the electro-magnet the results are otherwise. As soon as equilibrium is destroyed between the antagonistic spring and the electro-magnet, the locking mechanism works and the carbons approach to a distance of several hundredths of a millimetre; then, almost instantaneously, the



influence of the electro-magnet becomes completely annulled, the antagonistic spring pulls back the armature to its first position and causes a new break of equilibrium which causes a fresh unlocking. The sensibility of the apparatus is such that it works in a continuous

manner, exactly as if it were worked by automatic mechanism instead of being dependent on two balanced forces.

The choice of a powerful motor in the Gramme regulator explains itself. In a workshop or in every other place, sheltered or unsheltered, the dust and oxidisation interfere very rapidly with the proper working of regulators having a feeble motor, and this in spite of the care taken by those in charge of the apparatus.

On examining the details of the apparatus, and notably those parts which refer to the carbon holder and to the electro-magnet, we cannot but observe the care taken by M. Gramme to give to his regulator all the durable qualities possible, both as regards the solidity and good working which characterises his other inventions.

By means of this lamp and a new machine with flat electro-magnets, of which we shall shortly give an account, five lamps of 150 burner-power were obtained with an expenditure of 6 horse-power. MM. Sautter and Lemarnier are actually constructing, according to designs of M. Gramme, a machine producing 10 lights in the same circuit, which will be exhibited at the Electrical Exhibition, and which will light one of the great rooms on the first floor of the Palais de l'Industrie.—*Revue Industrielle.*

POPP AND RESCH'S PNEUMATIC CLOCKS.

AT the beginning of 1877 a system of pneumatic clocks was inaugurated in Vienna, and this having met with great success, the system has recently been tried in Paris, where over 2,000 of these clocks are now working in three districts only (the piping in the streets being over 15 miles, and that in the houses over 18 miles in length), and a contract is actually under signature with the municipality of that town for supplying the pneumatic time to all the public street and monument clocks throughout the town, a monopoly of 50 years being granted for the purpose to the Compagnie Générale des Horloges Pneumatiques, which company intends at the same time to extend the pneumatic distribution of time to private houses and firms throughout the whole area of Paris. A very important and similar contract is also at present under the consideration of the Vienna municipal authorities. These facts prove that the installation of the pneumatic principle has passed quite beyond the experimental stage, and is now quite a practical success.

The clocks are worked by air compressed at the central works and stored into receivers or reservoirs at a low pressure, which is sufficient for the work to be done. Systems of piping radiate from the central works through the town in which it is proposed to pneumatically distribute the time. The systems of piping are somewhat analogous to the gas piping, as smaller pipes are, as is the case with gas, branched from the mains into the houses, and branched again from the ascending branch pipes into rooms and apartments, &c.; but with this exception, that they are of much smaller dimensions altogether, the main pipes not exceeding one inch internal diameter. A main clock, which is accurately timed by means of a special contrivance, every minute opens a valve, which allows the compressed air to be discharged in the systems of piping. A very short time afterwards the same valve is shut, and the systems of piping put in communication with the atmosphere, by which the compressed air which they contain is discharged. This forward and backward motion of the compressed air, which is repeated automatically every minute, causes a bellows contained in each clock to correspondingly ascend and descend, the ascending motion forwarding, by means of a ratchet wheel, the hands of the clock one division, or one minute, at a time, the circumference of the ratchet wheel being divided into 60 divisions.

The mechanism for working each clock is shown by fig. 1, and it is, as can be seen, of the simplest character. The ratchet wheel is connected direct to the minute-hand and to the hour-hand by the usual gearing. The pawls, it will be seen, are maintained in their proper position by being weighted, so that they cannot well get wrong.

When it is desired to make the clock a striking one the movement of the ratchet lever winds up the striking mechanism.

The normal clock for regulating the pulsations of compressed air every minute is shown in general view by fig. 2. By means of mechanism somewhat similar to the striking mechanism of a clock an eccentric on one of the wheels of the train makes at a given time a half revolution, thus moving a valve and liberating the compressed air into the street mains. This valve is kept open for 20 seconds, and then the eccentric makes another half revolution, which shuts the compressed air off and puts the street mains in communication with the atmosphere.

Fig. 3 is an elevation partly in section, and fig. 4 a horizontal section of a balanced side valve which effects the distribution of the compressed air.

This valve is constructed as follows:—The compressed air is admitted from the reservoir through the tube, P, into the valve chest, Q, by the orifice or inlet, R. The orifice or outlet through which the air passes from the valve chest into the system of pipes is shown at S, and an escape pipe for the same at T. When the slide valve, U, is in its normal position the outlet, S, and the exhaust-pipe, T, communicate, and the air in the conduit pipes of the system is at the same pressure as the atmosphere.

At the proper time the controlling clock actuates the rod of the valve by means of the connecting rod, V, and the lever, X, and the slide valve is thereby so operated that it uncovers the outlet, S, whilst covering the escape-pipe, T, but without covering the air-inlet, R. The compressed air then enters the outlet, S, penetrates into the conduit pipes, and actuates the clocks in the circuit. The slide valve then returns to its original position, the orifices, S and T, are put in communication, and the compressed air in the system escapes.

To diminish the friction of the slide valve upon its seat, the slide, U, is provided with a cylinder, U^1, in which a piston, U^2, works; upon its rod a roller, Y^1, is mounted, travelling upon a cross-bar, Z, firmly fixed in the interior of the valve chest; thus the friction of the slide upon its seat is to a great extent transformed into rolling friction by the action of the roller, Y^1, upon the cross-bar, Z. In practice the friction of the slide upon its seat will be found to be

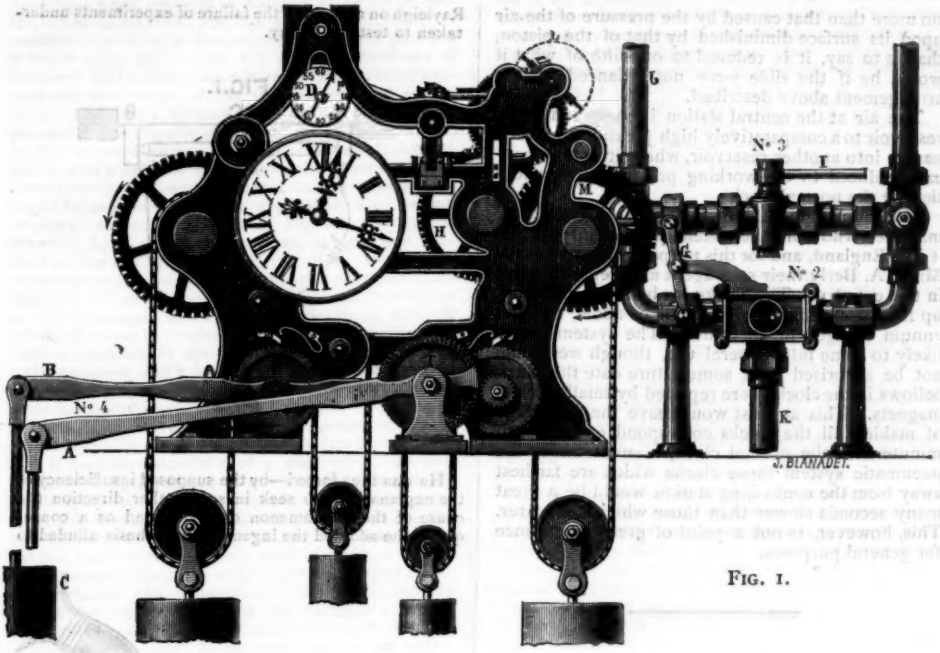


FIG. 1.

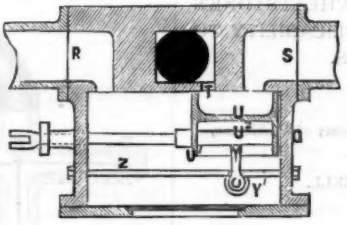


FIG. 4.

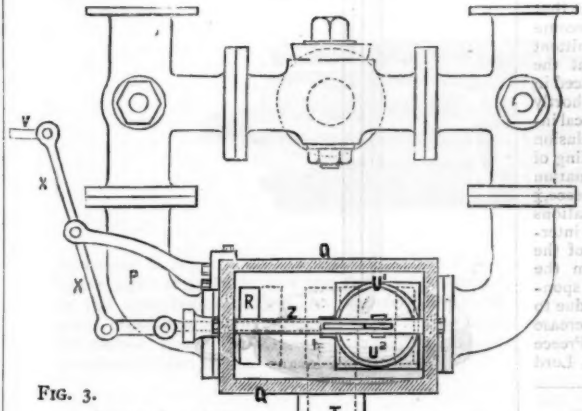


FIG. 3.

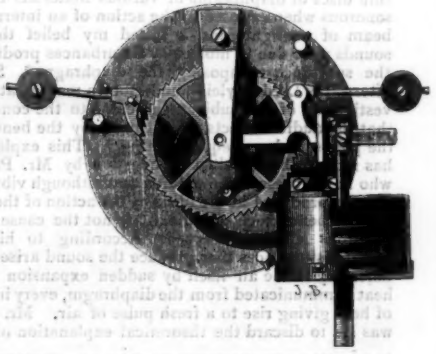


FIG. 2.

no more than that caused by the pressure of the air upon its surface diminished by that of the piston, that is to say, it is reduced to one-fifth of what it would be if the slide were not balanced by the arrangement above described.

The air at the central station is compressed in a reservoir to a comparatively high pressure, and then passes into another reservoir, where it is automatically reduced to the working pressure for distribution by the normal clock.

The Compagnie Générale des Horloges Pneumatiques, who work the system, purpose introducing it into England, and for this purpose have appointed Mr. J. A. Berly their sole agent and representative in this country. The clocks, we believe, will be put up free of expense, and a rental of about 15s. per annum charged for their use. The system seems likely to come into general use, though we should not be surprised if at some future date the small bellows in the clocks were replaced by small electromagnets. This at least would have the advantage of making all the clocks correspond exactly each minute with the normal clock, whereas under the pneumatic system those clocks which are farthest away from the controlling station would be a great many seconds slower than those which are nearer. This, however, is not a point of great importance for general purposes.

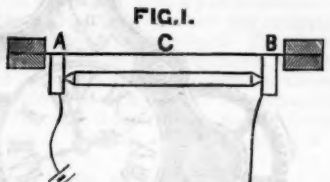
UPON A MODIFICATION OF WHEATSTONE'S MICROPHONE AND ITS APPLICABILITY TO RADIOPHONIC RESEARCHES.

A Paper read before the Philosophical Society of Washington, D. C., June 11th, 1881,

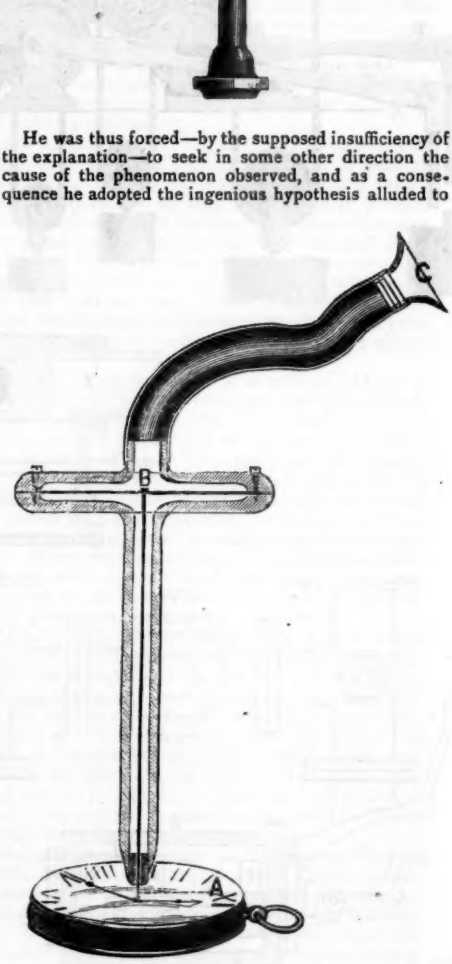
By ALEX. GRAHAM BELL.

IN August, 1880, I directed attention to the fact that thin discs or diaphragms of various materials become sonorous when exposed to the action of an intermittent beam of sunlight, and I stated my belief that the sounds were due to molecular disturbances produced in the substance composing the diaphragm.* Shortly afterwards Lord Rayleigh undertook a mathematical investigation of the subject, and came to the conclusion that the audible effects were caused by the bending of the plates under unequal heating.† This explanation has recently been called in question by Mr. Preece,‡ who has expressed the opinion that although vibrations may be produced in the discs by the action of the intermittent beam, such vibrations are not the cause of the sonorous effects observed. According to him the aerial disturbances that produce the sound arise spontaneously in the air itself by sudden expansion due to heat communicated from the diaphragm, every increase of heat giving rise to a fresh pulse of air. Mr. Preece was led to discard the theoretical explanation of Lord Rayleigh on account of the failure of experiments undertaken to test the theory.

FIG. 1.



He was thus forced—by the supposed insufficiency of the explanation—to seek in some other direction the cause of the phenomenon observed, and as a consequence he adopted the ingenious hypothesis alluded to above. But the experiments which had proved unsuccessful in the hands of Mr. Preece were perfectly



* Amer. Ass. for Advancement of Science, August 27th, 1880.
† *Nature*, vol. xxiii., p. 274.
‡ Roy. Soc., March 10th, 1881.

successful when repeated in America under better conditions of experiment, and the supposed necessity for another hypothesis at once vanished. I have shown in a recent paper read before the National Academy of Science* that audible sounds result from the expansion and contraction of the material exposed to the beam; and that a real to and fro vibration of the diaphragm occurs capable of producing sonorous effects. It has occurred to me that Mr. Preece's failure to detect with a delicate microphone the sonorous vibrations that were so easily observed in our experiments might be explained upon the supposition that he had employed the ordinary form of Hughes' microphone shown in fig. 1, and that the vibrating area was confined to the central portion of the disc. Under such circumstances it might easily happen that both the supports, *a b*, of the microphone might touch portions of the diaphragm which were practically at rest. It would of course be interesting to ascertain whether any such localisation of the vibration as that supposed really occurred, and I have great pleasure in showing to you to-night the apparatus by means of which this point has been investigated (*see* fig. 2).

The instrument is a modification of the form of microphone devised in 1827 by the late Sir Charles Wheatstone, and it consists essentially of a stiff wire, one end of which is rigidly attached to the centre of a metallic diaphragm, B. In Wheatstone's original arrangement the diaphragm was placed directly against the ear, and the free extremity of the wire was rested against some sounding body, like a watch. In the present arrangement the diaphragm is clamped at the circumference like a telephone-diaphragm, and the sounds are conveyed to the ear through a rubber hearing-tube, C. The wire passes through the perforated handle, and is exposed only at the extremity. When the point was rested against the centre of a diaphragm upon which was focussed an intermittent beam of sunlight, a clear musical tone was perceived by applying the ear to the hearing-tube, C. The surface of the diaphragm was then explored with the point of the microphone, and sounds were obtained in all parts of the illuminated area and in the corresponding area on the other side of the diaphragm. Outside of this area, on both sides of the diaphragm, the sounds became weaker and weaker, until at a certain distance from the centre they could no longer be perceived.

At the points where one would naturally place the supports of a Hughes' microphone (*see* fig. 1) no sound was observed. We were also unable to detect any audible effects when the point of the microphone was rested against the support to which the diaphragm was attached. The negative results obtained in Europe by Mr. Preece may therefore be reconciled with the positive results obtained in America by Mr. Tainter and myself. A still more curious demonstration of localisation of vibration occurred in the case of a large metallic mass. An intermittent beam of sunlight was focussed upon a brass weight (1 kilogramme), and the surface of the weight was then explored with the microphone shown in fig. 2. A feeble but distinct sound was heard upon touching the surface within the illuminated area and for a short distance outside, but not in other parts

In this experiment, as in the case of the thin diaphragm, absolute contact between the point of the microphone and the surface explored was necessary in order to obtain audible effects. Now, I do not mean to deny that sound-waves may be originated in the manner suggested by Mr. Preece, but I think that our experiments have demonstrated that the kind of action described by Lord Rayleigh actually occurs, and that it is sufficient to account for the audible effects observed.

* April 21, 1881.

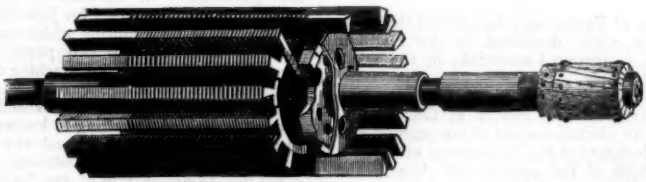
THE WESTON ELECTRIC LIGHT SYSTEM.

THE Weston Electric Light system, which has recently been introduced into this country, claims to produce the electric light more practically and economically than any known system. The light is stated to be entirely free from the disagreeable blue and violet rays which are so trying to the sight and which give the ghastly appearance to the complexion. The arc is peculiar for its great steadiness, being maintained at the point of the carbon, instead of moving from side to side, as in other divided lights.

The Weston machine runs at a comparatively low speed with light belts, and is very free from sparking at the brushes.

While there are some points of resemblance in the construction of the various light machines, the armature used in the Weston machine differs from any other form in use.

This armature, which is shown by the figure, is



constructed of sectional plates of metal, with space between each, in such a manner as to be opposite similar slits or openings in the inductors of the large iron electro-magnets. When in motion the current of air passes out of these slits, being propelled from the centre to the surface by centrifugal force on the same principle as the action of a rotary fan blower. This continuous current of air, taken in cool at the centre, and blowing out at the circum-

ference, is most effectual in keeping the machine cool.

In the Weston lamp the lower carbon is fixed, and the upper one is suspended from a rod which is capable of sliding freely up and down, but whose motion is regulated by small clamps worked by an electro-magnet. When the magnet is excited, its attraction closes the clamps and draws the carbon up. When the current becomes weakened, the clamps relax, and allow the carbon to slide down. The carbons employed in the lamps are claimed to be of very high quality, so that they burn with great steadiness.

During the last week an exhibition of the Weston apparatus has been held at the Albany Works, Euston Road, by the exhibitors of the Maxim light. Ten lamps were driven from one machine, and all burned with great regularity and steadiness.

A very large number of the machines and lamps are being imported into this country. The larger machines will drive over 20 lights.

Notes.

ELECTRIC FIRE ALARM.—By M. A. Ledien.—This instrument consists of a piece of wood connected to the wires of a constant battery, such as that of Daniell, by means of strong copper screws sunk up to the head. This piece of wood is kept always slightly moist by being wrapped in some porous material, communicating by means of filaments of the same substance with a vessel of water. It is placed in the interior of the powder magazine, or other store, whose temperature it is necessary to watch. The battery is outside, and a very sensitive galvanometer is introduced into the circuit. This galvanometer indicates by the movements of its needle the variations in the dryness of the wood. It is placed fully in view, and the needle may be arranged so as to sound an electric alarm-bell on reaching zero.—*Comptes Rendus.*

CLOCKS WOUND-UP BY ELECTRICITY.—H. Füster, of Posen, has sent to the Electrotechnisch Verein the drawing of a clock which winds itself up by means of electricity.

JOSEPH ZIMBER, of Furtwanger, has solved the same problem, and his clock, described in the German patent, No. 12649, is arranged essentially in the same manner as that of Füster.

DRS. VAN FEILITZSCH AND HOLTZ, of Greifswalde, have constructed an electro-magnet of uncommon size for the Physical Institute of the University of Greifswalde. The weight of the core is 628 kilos.; the number of layers of wire is 25, and the weight of the wire, 275 kilos.

DIVISION OF THE ELECTRIC LIGHT.—By Professor M. Avennarius.—The principle upon which the author bases the distribution of the electric light consists in making electric burners which derive their current from a source of electricity independent of each other. Suppose that in the circuit of a dynamo-electric machine four electric burners are introduced, I., II., III., and IV. In this, which has been hitherto the common connection of the lights, every fault of one of the lights, say I., occasions a weakening of the current, involving, of course, an enfeebled action of the remaining lights, II., III. and IV., which again reacts upon the current and upon the burning of No. I. A light which is perfectly constant, if introduced singly into a circuit, may, therefore, in the above case waver very perceptibly. But as all the lights of the circuit are exposed to the same conditions as I. the faults of all are reproduced in each, and regular burning is out of the question.

That only burners of equal strength can be introduced into such a circuit is self-evident. But if we suppose each light fitted with a lateral branch, 1, 2, 3 and 4, so that the current is divided before entering each of the lights, a part of it only passing the light and the rest the side-branch, we may conceive conditions which may make the lights so far independent of each other that their burning may be perfectly satisfactory. These conditions are:—

1. The current must chiefly pass through the light and not through the side-branch, in order not to occasion any loss of work by heating the latter.

2. Any weakening of the burning of a light (consequently an increase of the resistance) must cause a more easy passage of the current through the side-branch, so that even the extinction of light I. may involve no appreciable change in the burning of the others.

If we leave regulators out of consideration, only three kinds of conductors are possible:—

1. If conductors of the first class are used, *i.e.*, metallic wires, those which answer the first condition will not fulfil the second, and conversely.

2. If non-conductors are used, *i. e.*, condensers, their capacity must be very great. When using varnished silk or tin-foil, Avennarius found that a condenser-surface of 20 square metres was too small to keep up the current. Jablochkoff succeeded with a condenser of 200 square metres. But on considering the expense which such a condenser involves, and the changes which the varnish suffers from time and from the action of the current, the hope of solving the problem in this manner must be abandoned.

3. The question may be solved by the use of conductors of the second class, *i.e.*, liquids.

Suppose we have a voltameter, *e.g.*, platinum in water acidified with sulphuric acid. As is well known, a current will not pass through unless the electromotor force of the battery equals two Daniell's elements. If we connect n voltameters to form an apparatus, which we may name a polariser, the electromotive force must $= 2n$ Daniells in order that the current may traverse this polarisator. If we have to do with alternating currents (such as are used for Jablochkoff candles), we can divide the time during which the stream retains a constant direction into two parts. In the first the electromotor force of the machine does not reach $2n$ Daniells, and the entire current passes through the light; in the second, where it exceeds $2n$ Daniells, the current is divided according to known laws. It is easy to arrange the polarisation and the resistance of the apparatus so as to fulfil conditions 1 and 2. As concerns the decomposition of the liquid in the polariser, the gases which are evolved during one direction of the current recombine when it takes the opposite direction, and no decomposition of the liquid is experienced. Hence, consequently, there is no expenditure of work to be feared in this direction. The most important result obtained is the mutual independence of the lights. Hence follows:—

1. The number of the lights can be considerably increased.

2. Lights of different strength can be introduced into one and the same circuit.

3. If one of the plates of the polariser is movable, its resistance can be varied, and the corresponding light can be made to burn more strongly or more feebly at pleasure.—*Zeitschrift für Angewandte Electricitätslehre.*

ON THE DISTRIBUTION OF THE ELECTRIC CURRENTS.—By M. Brillouin.—The author considers a wire connected at its ends with a system of closed conductors, or with accumulators of such a size that the intensity of the current in the whole wire can be regarded as constant in any moment. The electromotor force in the wire, E, results from the formula:—

$$E = R\,i + \frac{d}{d\,t}\,(2\,w\,i + \Sigma\,W\,j) + \frac{d\,N}{d\,t} + V_B - V_A.$$

V_B and V_A are the variable electrostatic potentials at the end of the wire; R the resistance of the wire, w the electro dynamic potential; W the potential of the neighbouring wires upon the wire, d N, (d t the work done at the unity) of the intensity in the wire of the permanent magnets from deformations of the wire and its relative changes of place.

He then considers a system of parallel wires whose ends are connected by the other unbranched wires of the circuit. He finds that the single streams do not in general follow Ohm's law. The latter comes into force only when the total energy of the intensity of the current in each wire has the same value at the end of the period as at the beginning. This is, *e.g.*, attained when the induction is elicited by the movement of magnets or currents situate outside the wires, or by a change of their intensity; or when single spirals in the branches of the currents revolve 360° round a diameter, or when all the spirals which have an inductive action upon each other revolve 180° without the action.—*Journal de Physique.*

ON AN EXPERIMENT OF PLUCKER'S.—By J. Moutier.—If a cylindrical magnet is placed in the middle of a magnetic bell, and if a point of the bell is connected by a wire with the upper end of the bell, a current passes through the wire if any one of the three parts of the magnet is moved. The electromotor force of the current is independent of the speed of the magnet, and depends merely on the relative speed of movement of the bell to the wire. Independently of any hypothesis on the nature of galvanic currents, Moutier considers that this phenomenon can be explained by the "electrotonic" state which is produced in the state of rest in the magnet, the bell, and the wire. On account of symmetry this condition remains unaltered when the magnet and the bell and the wire revolve together, but only when the relative positions of the parts of the system are charged by a movement of the bell or the wire.—*Bull. Soc. Philomath.*

ON THE ELECTRIC BEHAVIOUR OF FLAME.—By W. Holtz.—The author prefixes to his own experiments a general account of all researches on the electric behaviour of flame. His own experiments refer chiefly to the changes of the form and colour of flames when positively or negatively electrified. The flames are here so arranged that they form in a manner one of the electrodes of an influence machine. The positive flame becomes bluer, narrower, more pointed, whilst similar phenomena are scarcely perceptible in the negative flame. The latter displays, however, a curious phenomenon; its point is turned towards its own conductor. Hereby, according to the strength of the electrisation and the width of the aperture of the burner, an intermittent and a constant retrogression may be distinguished. The negative flame takes the most curious shape when it issues from a large disc, or when it burns round a metal cylinder. It is then bent backwards towards the metal surface, either in a curve or an angle, according to the strength of the electrisation. Its point in the latter case is divided into two tufts of a peculiar shape, which on their part make movements more or less similar.

Further differences result if a conducting body is held opposite to a flame which burns as an electrode. At a considerable distance each flame bends towards it; on approaching nearer there occurs a repulsion of the negative and an attraction of the positive flame. In the latter case the attraction extends only to the upper more luminous part, not to the foot of the flame which is still repelled. Herewith is connected the circumstance that a positive flame easily passes through wire gauze whilst the negative flame remains below. The pointed form of the positive flame is the cause that it readily drives a wheel with vanes, whilst the negative flame scarcely sets it in motion. All these and other distinctions appear especially in an unmixed gas flame, or in that of stearine, wax, or tallow, less in the flame of alcohol, and least in that of a Bunsen burner, being the less manifest the richer the flame in oxygen.

The phenomena in question are produced not merely on direct electrisation, but also when the flame is exposed to the influence action of a large disc. If a flame is introduced between two smaller electric discs, it inclines to the negative side, spreading itself out. With a certain strength of current it vibrates to and fro like a pendulum, and displays a peculiar stratification. These phenomena also occur the less the richer is the flame in oxygen. It is accordingly probable that carbon and hydrogen are attracted more to the negative, but oxygen more to the positive pole, perhaps—like every distinctively polar attraction—in consequence of a certain uni-polar conductivity of the substance in question. The retrogression of the flame is thus explained: the point of the flame loses more electricity by influence than it receives by conduction. A strip of paper, one end of which is pasted to a large ball, displays similar movements as soon as the free end is pointed and made more conductive. There are two causes why the negative becomes retrograde. Either the point of the flame has here an exceptional radiating power, or the foot of the flame is here an exceptionally bad conductor. The former supposition agrees with the experiments of Wiedemann and Rühlmann, and the latter with Erm an's observation on the uni-polar conduction of flames. Other grounds speak in favour of the existence of an uni-polar conduction. The resistance observed by Hittorf at the negative electrode cannot explain Erman's experiments, since if negative electricity penetrates into the flame with more difficulty, positive electricity must have more difficulty in making its exit.

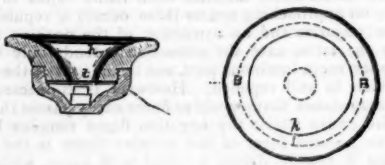
Herwig's explanation of the above resistance by the assumption of a negative specific electricity does not agree with the fact that the flame is drawn exactly to the negative pole. It may otherwise be concluded that the specific electricity of flame can play no essential part in the phenomena above mentioned.—*Wiedemann's Beiblätter.*

THE Earl of Crawford and Balcarres, F.R.S., has been appointed British Commissioner to watch over British interests at the forthcoming electrical exhibition at Paris. The appointment of his lordship, who is better known as Lord Lindsay, has been received with great approval. The exhibition will open on August 1st without fail.

M. PLANTÉ is about to establish a factory for the manufacture of his secondary batteries. He contends

that his form is in reality better than M. Faure's modification, as the latter cannot be charged except by a battery, whereas the simple lead-plates can be worked by a magneto-electric machine.

A TELEPHONE has recently been patented (Patent No. 242,156, filed Jan. 29th, 1881) by Mr. C. W.

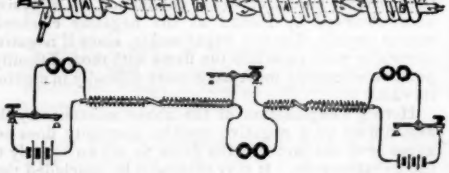


Raymond, of New York. In this telephone, which is shown by the figure, there is a supplemental diaphragm which covers the mouthpiece.

THE whole of the text of the revised version of the New Testament was transmitted from New York to Chicago on the evening of May 20th. It consisted of 110,000 words, and was started on four wires at 5.30 p.m. At 6 p.m. eight wires were used; at 7.30 p.m. sixteen wires, and at 8.45 p.m. twenty wires. It was finished at 12.20 a.m.

LLOYD'S Committee have made application to the Clyde Lighthouses Trust for accommodation at Cumbrae for an operator to work a telegraph signalling station there. The request has been granted by the Trust, so that there is now every prospect of having telegraphic communication from that quarter very soon. Lloyd's Committee are also making inquiry as to which would be the best point in the North Channel—Tory, Innistrahul, or Rathlin—for establishing another signalling station, and the same committee have further in view the propriety of establishing a signalling station at Pladda or on the Holy Isle.

A PATENT (No. 242,343, filed April 16th, 1881) has been taken out in America by Orazio Lugo for a telegraph circuit consisting, as shown, of an electric



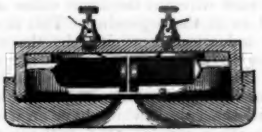
conductor formed of two or more solenoids connected together in series, and having the helical conductor of each solenoid joined to the axial conductor of the next solenoid in series in each direction, and *vice versâ*.

A RECENT observation by Herr Holtz throws some light on the question as to the penetration of electricity into the mass of an insulating plate. He held an ebonite disc of 1½ mm. between the pointed discharge-rods of a Holtz machine, then laid the charged disc on a table (being diverted from an experiment of another kind he had intended). In about a quarter of a minute he heard a weak discharge, and found the disc broken. He repeated the effect with another disc. Considering (he says) that the charge of the plate, after this was left to itself, could not possibly have been strengthened, but must have diminished rather, the result proves unmistakably that the opposite electricities must come next one another. The effect was not obtainable with glass discs.

A TRAMCAR has been driven in Paris by means of Faure's accumulators. It conveyed forty persons at the rate of six miles an hour, the motive power being 160 Faure batteries, weighing 18lb. each, altogether 2,880lb.

DURING the past four years the overhead wires in London have been reduced from 1,720 miles to 500, and the underground work increased from 3,350 to 4,388. There has thus been a reduction of 1,220 miles in the overhead work, and an increase of 1,038 miles in the underground work, so that the total mileage of line has been reduced; this is due, however, to a better arrangement of the circuits.

THE telephone shown by the figure has been patented (No. 242,204, filed Dec. 17th, 1881) in America by Mr. C. A. Hussey. It consists of a diaphragm, a per-



manent magnet of continuous or endless form provided with poles or consequent points, one or more of which extend towards the centre of the diaphragm, and which are wound with wire.

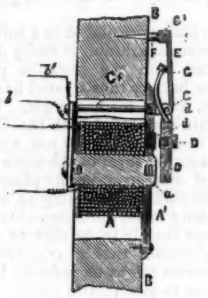
AN improved form of standard resistance coil has been devised by Professor Fleming, of the Cavendish Laboratory, Cambridge. The wire forming the resistance, instead of being bedded in paraffin wax as in the old forms of coils, is surrounded by an air space. This arrangement has the great advantage of enabling the wire to take the temperature of the medium in which the whole arrangement is immersed, in a few minutes.

SWAN ELECTRIC LAMP AT PLEASLEY COLLIERY.—The Royal Commissioners upon Accidents in Mines, including Professor Abel, Mr. Warington Smyth, Professor Tyndall, and others, made an examination last week of the experiments on the application of electric lighting to coal mines which are being carried out at the Pleasley Colliery, near Mansfield. The pits are about 1,600 ft. deep, and the workings are very extensive, but in the present instance the light was applied to three workings only, situated at a distance of about one-third of a mile from the bottom of the pits. The Swan system was adopted, and the arrangements were carried out by Messrs. R. E. Crompton and Co. The lamps themselves were inclosed in lanterns of a very ingenious construction, designed and made by Messrs. Crompton, which enabled the very fragile glass bulbs to be carried about without fear of accident, and at the same time rendered it impossible that the fracture of the lamp within could cause an explosion, inasmuch as the air inside the lantern would suffice for the instantaneous combustion of the carbon filaments before the flame could be communicated to the external air. In working the coal, the men undercut the face to the depth of some five or six feet, and the superincum-

bent mass is then brought down by wedges or blasting. It is said that the new lamp was found to be admirably suited for the requirements of the workers, since it not only gave a light many times as intense as the lights it replaced, but it was equally brilliant in whatever position it was placed, and it required absolutely no attention. In addition to the lamps which were used in the actual workings of the pit, the pit bottom was lighted up with similar lamps. The number of lights employed was 94 in all, which were worked by the current of an ordinary Gramme machine driven by a portable engine placed near the top of the upcast shaft.—*Journal of the Society of Arts.*

MR. EDISON has asked for 120 horse-power at the forthcoming electrical exhibition at Paris, to work his large generator.

MR. W. H. SAWYER has patented in the United States (Patent No. 242,055, filed Jan. 17th, 1881) the form of electric communicator, which is shown by the figure. In this invention the indicating-drop is held



in its upright position by a permanent magnet, whereby is obviated the throwing down of the drop by jarring, currents of air, rebounding, or other unintentional agencies. There is a pendant armature, D, provided with pin, G, a pivoted drop, E, and a magnetic pin, F. The pendant armature, D, is provided with a removable screw, D', a screw or contact-piece, *d'*, having a wire, *b*, connected to it, and a wire, *b'*, electrically connected with the armature.

DUBLIN ELECTRIC LIGHT COMPANY, LIMITED.—This undertaking has been formed with a capital of £150,000 in £10 shares, of which the first issue is 7,500 shares, for the purpose of introducing the electric light in Dublin for public and domestic use. The prospectus states that the company have entered into an agreement with the Anglo-American Brush Electric Light Corporation of London—the owners of the "Brush" Patents—to sell their patent machines, lamps, &c., and all future improvements thereon, exclusively to the company, for the county and city of Dublin. The price to be paid to the Anglo-American Corporation is £1,000 in cash and £9,000 in shares. The company are in negotiation for the lighting of several railway stations, factories, &c.

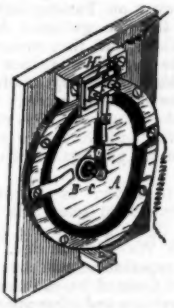
M. EMILE BERLINER, who claims to have been the original inventor of the contact telephone, has patented in America (Patent No. 241,912, filed Dec. 2nd, 1879) the form of the instrument, shown by the figure. His claims in his patent are as follows:—

1. In a contact-telephone or microphone, the combination, with the diaphragm and electrode vibrated by it, and a spring and electrode carried thereby, of a second spring projecting over and parallel with the first-named spring, and means, as indicated, for adjusting its pressure against the latter, and consequently of the two electrodes against each other, substantially as described.

2. In a contact-telephone or microphone, an elastic electrode, which is pressed against the opposite electrode by a spring, which can be shortened or lengthened as and for the purpose described.

3. In a contact-telephone or microphone, the combination of a vibrating surface forming one electrode, and being carried by a diaphragm in contact with a curvilinear convex surface forming the opposite electrode, the latter being attached to a flat spring, the elasticity of which is adjustable, substantially as and for the purpose set forth.

4. In a contact-telephone or microphone, the combination of a vibrating surface forming one electrode, in contact with the elastic opposition electrode, the latter being pressed against the former by a movable



piece, G, attached to a stationary spring, substantially as and for the purpose set forth.

5. The combination, with a spring and electrode carried thereby, of a second spring held stationary at one end, and arranged to bear against the spring carrying the electrode, and means, as indicated, for adjusting its pressure, substantially as described.

TELEGRAPHIC COMMUNICATION WITH SHETLAND.—The Shetland Islanders have a grievance in the very frequent interruptions in the telegraphic communication between Shetland and the South. There was not a single week all last winter that one or two annoying stoppages did not occur. The line passes over the Orkney Islands and through its impetuous tideways. There are no fewer than twelve land connections, and it lies on a rocky bottom. Early in the spring this matter was brought under the notice of the Postmaster-General; but Mr. Fawcett stated that a new line would cost £10,000, and that the present cable did not pay. On March 6th the cable broke altogether, and since then Shetland has been entirely without communication with the South by wire. A memorial was then forwarded to the Postmaster-General, in which it was argued that the sole possible trade of Shetland—its fishing—depended upon telegraphic communication with the markets for its development. Mr. Fawcett promised that no time would be lost in sending a telegraph ship to repair the existing line. The Shetlanders argue that it is not fair to hold them responsible for the sum of £4,000, which is annually expended upon repairs, almost the whole of which are rendered

necessary by the breakages in Orkney; and that for a sum not exceeding the amount expended every two years on such repairs they could have a direct cable, lying on a sandy bottom all the way, and steering clear of all tideways and land connections, which would last without repair for twenty years to come. They appeal to the members of the British House of Commons to help those who are trying all they can to help themselves.

TELEPHONE SCHOOL.—A telephone training school has been established at Upper Norwood, with the object of giving its pupils thorough practical instruction as electricians and experts, with a view to meet the demand for such persons which is constantly increasing. Mr. C. E. Winter, late of the Postal Telegraph Department, is the principal of the school.

THE ELECTRIC LIGHT IN THE COMMONS.—The second experiment of lighting the House of Commons by electricity during a debate was recently made, and the results were much more satisfactory than those on the previous trial a fortnight ago. Mr. S. Lefevre in the House, however, on Tuesday last, in reply to Mr. O'Shea, stated that he gathered from the general opinion of members that they were not satisfied with the result of the experiments; but they were made under considerable disadvantages. He would postpone further experiments until the recess. Twelve Brush arc-lights replaced the seventy-two gas ring-burners in the body of the House, and thirty-two small Swan lights took the place of the gas jets under the galleries.

THE ELECTRIC LIGHT IN EDINBURGH.—It is, we understand, proposed to select the Brush system for experimentally lighting Prince's Street, the North Bridge, and the Waverley Bridge. The cost of the three months' experiment will be about £390, but should the Town Council be satisfied with the results attained, the machines and other apparatus can be purchased for £2,400 less the above sum. It is also contemplated to establish a circuit to Holyrood, so that the Palace square may be well lighted during Her Majesty's stay in the city. The directors of the North British Railway Company have arranged with the Town Council for the lighting of the Waverley Station by electricity.

THE TELEPHONE IN HAMBURG.—The establishment of a telephonic network in Hamburg (says a German contemporary) is progressing most rapidly. Two hundred and thirty-one offices are already open, and almost every office and place of business in the town will ultimately be telephonically connected.

AT a meeting of the Edinburgh Plans and Works Committee, held on the 16th ult., leave was asked to erect poles for telephone wires in various parts of the city on property belonging to the Corporation. Permission was given, and an annual rental of 2s. 6d. per pole imposed. A conversation took place on the dangers of overhead wires, but no recommendation made.

THE inhabitants of Burray, one of the largest and most important of the Orkney Isles, are about to present a petition for telegraphic communication with the mainland.

A TELEGRAPH office is to be opened at Finstown, Orkney, under a guarantee of £22.

THE Select Committee appointed by the House of Commons to inquire into the Herring Branding in Scotland, have reported in favour of a portion of the surplus branding fee being expended in aiding the Post-Office to extend telegraphic communication to some of the remote fishery districts.

BY the erection of two new lines, and the substitution of telephones for Wheatstone's A.B.C. on the previously existing lines, the Post-Office has put the Dundee central police-station in telephonic communication with the various district stations, including Lochee.

Correspondence.

STORAGE OF ELECTRICITY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Since many are now interested in the so-called storage of electricity, I venture to describe a battery which I have recently devised, which gives very positive results.

Two carbon plates are placed in a solution of sulphate of zinc; the zinc in solution is easily deposited on the plate connected with the negative pole of a small Gramme. The battery thus treated has then a zinc and a carbon plate, and is ready for use. When it has run down it is again connected with the Gramme and recharged, and is again ready for use, no zinc being lost. I have made another form of the same battery in which two surfaces of mercury take the place of the two carbon plates, one surface becoming an amalgam of zinc. I am now making exact measurements of all that takes place, and hope shortly to be able to make the results known. It is obvious that a large amount of waste in telegraph batteries might be reduced by subjecting the sulphate of zinc to electrolytic action.

Faithfully yours,

FREDERICK JOHN SMITH.

Taunton, *June 17th*, 1881.

ELECTRIC LIGHTING IN THE CITY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Referring to the letter of your correspondent, "Electrician," in your last number, I will take as correct his statements. These, however, do not in any way alter my views regarding the simplicity which is in "Jablochkoff," even in its working details. I may here remark that when the Embankment lights were first started the commutation or change of candle took place every hour and a half, and from each individual lamp-post. On a renewal of contract and increase on the number of lights used, an improvement took place, and one or two circuits were switched from the same spot. Progress has steadily gone on since, and now by the plan adopted, there is nothing to prevent any number of lamps being at once lit, and all commutation going on from the engine house itself. The "life" of the candle is now three hours, and I have no doubt before long *that* will be much increased. It matters little, as before said, what the *modus operandi* is, as long as a light, good and pleasant to the eye as to colour, is given, and at a price below gas. Now, whether two or twenty wires are required, I maintain that a system which enables three or four men to work and control from one spot, in some cases far distant from where the light is to be used, any number of electric lamps, is itself simplicity. The wires connected with its working, whether few or many, are merely a

matter of capital sunk, and if I judge by the quantity used in telegraphy and the results obtained, I have no fear of the operation of the "Jablochkoff" system of electric light being prejudiced or impaired by the question of number or length of wire. That the Metropolitan Board of Works have now got a contract for the Embankment on this system, costing them less than gas, and giving them a light transcendently greater, is, I believe, a fact, and speaks volumes. Comparisons are, doubtless, odious; but you will allow me to call your correspondent's attention to the three systems now before the public. The Metropolitan Board or Works have been lighting their great thoroughfare for nearly three years "without a failure for a single hour," without a change of a single screw to plant or lamp, save such as was necessary upon the extension or renewal from time to time during the above-named period. *Another* system within three months of its appearance had to suspend altogether for a fortnight, re-laying wires and taking down the whole of their lamps; while a *third*, after advocating lights of immense intensity, placed at a great altitude, have already lowered them 50 per cent. I say nothing in the last two cases of the occasional disablement and want of action—this all regulators are heir to. *The economy* of continuous currents is not disputed; but since it is attended by drawbacks which have puzzled electricians of all nations for nearly 50 years, I mean the unequal combustion of the electrodes, the cause being "regulators," more or less regular, from the earliest lamp to the multitude we have lately seen patented, I think that the claim for M. Jablochkoff's invention (the merit of simplicity) is but scant justice. It is indeed a wonderful invention, and the French nation took that view of it when bestowing on its author the Legion of Honour and the Gold Medal at the Exhibition of 1878. I must say I have looked in vain for anything that can approach it in scientific as well as practical value.

Your obediently,

Junior Carlton Club. ELECTRON.

TELEPHONIC PERTURBATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I read with interest the communication of your correspondent "Telephone," in the last issue of the Journal, on the subject of telephonic perturbations, in which several experiments which had been made were carefully described. Several deductions from the experiments were also given, upon which, with your permission, I will venture a few remarks.

In the first place, it will generally be admitted by those who have had any experience of telephones that M. Gaiffe is perfectly right in concluding that part of the disturbance heard in the telephone is due to causes other than induction. If the office "leads" of the telephone, especially those of the primary circuit, are allowed to rub against each other, or against another object, the sound is reproduced in a magnified form in the telephone; and it is quite possible that the friction at a loose "binder" may produce sound in the telephone in like manner, or, as your correspondent suggests, it may be partly due to the vibratory action of the wind. Is it correct, however, to say that the wind "sets up currents" in the wires? Are not these peculiar noises, if they are really caused by the wind, simply waves of sound?

Secondly, I cannot conceive why it is necessary to put *telephone* circuits to a different earth from *telegraph* circuits, and I have not experienced the difficulty referred to by "Telephone." If he found that by using the earth of a *telegraph* circuit the movements of the telegraph apparatus were reproduced in the telephone, his earth must have been very imperfect, offering, as it must have done, a resistance equal to that of the telephone, or, what is more likely, the earth wire must have run for some distance alongside other wires in actual use, and thus caught up the induction. At the same time, if the water pipes of a town are used at one end of the line, and a copper plate at the other, a sufficient difference of potential may thus be obtained to excite the telephone.

Thirdly, galvanometers *might* be used on telephone circuits, but there are many decided objections to them. In the meantime, when an interruption occurs, renters presumably examine their connections, and, although galvanometers were supplied, they could do no more. It is useless to argue that renters would be enabled to indicate where the lineman should be sent. They could not do so without short-circuiting their apparatus, a proceeding which would be more likely to create than diminish faults. Any testing that is required can best be done by the lineman when he arrives with his detector, and, although he has to walk the entire length of the average telephone circuit, the "travelling and other expenses" will not be very serious. The cost of the galvanometers, and the resistance they would add to the circuit, are also important considerations—so important, indeed, that even in short telegraph circuits their use has been abandoned.

Yours obediently,

Edinburgh, *June 23rd*, 1881. INDUCTION.

IMPROVED ELECTRO-MOTIVE ENGINE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Referring to the article on an electro-motive engine on page 229, I should be very glad to receive the following information, either from the writer of the article, or some of your valuable correspondents.

(1.) Would the electro-motive engine driven by three of the bichromate cells give one man-power? if not, what power might be expected, also how many cells and what size would be required to give one man-power?

(2.) What quantity of solution should flow through each cell per hour?

(3.) Would it do to let the solution flow out of the first cell into the second, and then into the third one? if not, why?

(4.) What would be the weight of the electro-motive engine giving one man-power, also the probable cost?

VOLT.

New Patents—1881.

2484. "Improvements in and relating to the neutralisation of induced currents caused in telegraph and telephone lines by currents in other lines attached to the same posts or supports." W. P. THOMPSON. (Communicated by F. Van Rysselberghe.) Dated June 8.

2492. "Improvements in electric lamps and the manufacture thereof and in systems thereof." P. JENSEN. (Communicated by T. A. Edison.) Dated June 8.

2495. "Electric arc lights." E. G. BREWER. (Communicated by T. A. Edison.) Dated June 8.

2532. "Electric cables." G. E. GOURAND. (Communicated by P. B. Delany and E. H. Johnson.) Dated June 10.

2538. "Electric and magnetic breaks, method of utilising the energy required to stop a railway train or other vehicles suddenly, and in the utilisation of such brakes and connections for various purposes on trains and vehicles." M. R. WARD. Dated June 10.

2542. "Improvements in electrical insulated wires and conductors and in the means of insulation of the same." S. J. MACKIE. Dated June 14.

2554. "Apparatus for receiving and transmitting signals by electricity." A. F. ST. GEORGE. Dated June 13.

2563. "Electric lamps." G. G. ANDRÉ. Dated June 13.

2572. "Improvements in electric lamps and in means for bringing a number of carbons successively into circuit and for varying or extinguishing the light. H. E. NEWTON. (Communicated by C. A. Hussey and A. S. Dodd.) Dated June 14.

2573. "Improvements in means for supporting and protecting wires and other conductors used for electrical purposes." H. E. NEWTON. (Communicated by C. A. Hussey and A. S. Dodd.) Dated June 14.

2592. "Improvements in the manufacture of telegraphic or telephonic conductors or cables, and in machinery therefor." W. R. LAKE. (Communicated by H. A. Clark.) Dated June 14.

2593. "Electric clocks." A. M. CLARKE. (Communicated by J. Schweizer.) Complete. Dated June 14.

2606. "Electric accumulators or secondary batteries." A. MUIRHEAD. Dated June 15.

2607. "Improvements in electric bells; applicable also to relays and other electrical mechanism." W. P. GRANVILLE. Dated June 15.

2612. "Construction of electric lamps and apparatus for electric lighting." W. CROOKES. Dated June 15.

2618. "Governing dynamo-electric machines and electro-dynamic machines." J. JAMESON. Dated June 16.

2635. "An improved floating apparatus for generating and conveying electricity for the production of the electric light and the transmission of power." W. C. JOHNSON and S. E. PHILLIPS. Dated June 16.

2703. "Electric appliances for moving and otherwise operating upon train and like carriages." J. RICHARDSON. Dated June 20.

2711. "Electric danger alarms or signals, and other safety appliances for railways." S. A. B. PUTNAM. Dated June 21.

2712. "Improvements in the method of transmitting secret correspondence by telegraph or other public mediums, also in the apparatus to be employed therein." D. NICOLL. Dated June 21.

2739. "Improvements in the mode of, and apparatus for, distributing electricity, applicable to the production of the electric light, and for other purposes." H. E. NEWTON. (Communicated by A. Gravier.) Dated June 22.

2761. "A new or improved electro-magnetic induction machine for dividing a direct current into alternate currents." L. A. GROTH. (Communicated by D. Lachaussée.) Dated June 24.

2770. "Electrical resisting mediums more particularly adapted for use in vacuum and other electric lamps and tubes." R. H. COURTENAY. Dated June 24.

2782. "Secondary batteries." H. E. NEWTON. (Communicated by Société Universelle d'Electricité Tommasi.) Dated June 25.

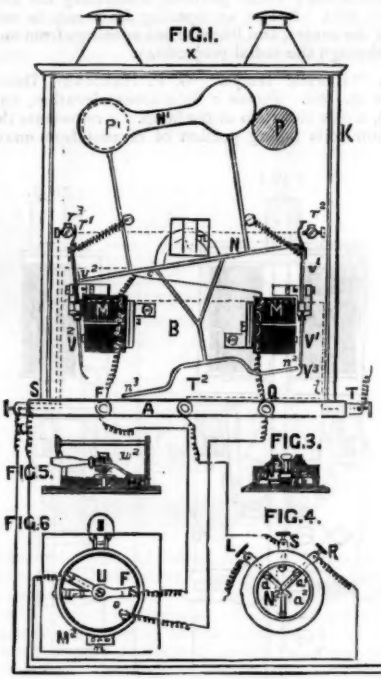
2788. "Means or apparatus employed in obtaining light by electricity." B. J. B. MILLS. (Communicated by F. Million.) Dated June 25.

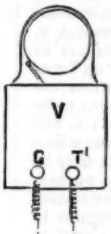
2807. "Telegraph cables and other conductors of electricity." A. C. RANYNARD and J. A. FLEMING. Dated June 27.

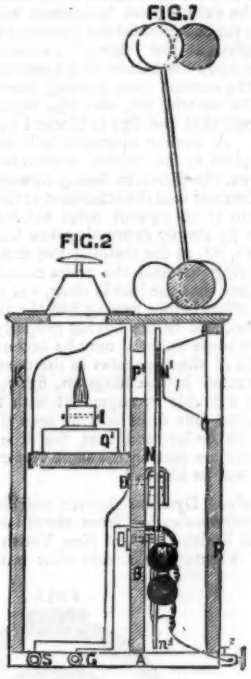
ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

4081. "Electrical signal apparatus for railways." W. R. LAKE. (A communication from abroad by Alfred Lemaire and Edmond Lebrun, both of Paris.) Dated October 7. 6d. Relates to apparatus for signalling on railways, which apparatus is particularly adapted for use in connection with single lines. Fig. 1 is an elevation of the apparatus with the outer casing removed. Fig. 2 is a sectional side elevation of the same in front of the swinging frame. Figs. 3 and 4 show the pusher-switch in section and in plan with the cover and pusher removed. Figs. 5 and 6 show in section and in plan the two-way switch or commutator. Fig. 7 is a diagram illustrating a modification of the invention. At each of the two stations to be placed in communication there is an electric signalling apparatus, X, a pusher-switch, N^2, a two-way switch, M^2, and an electric bell, V. The signalling apparatus (figs. 1 and 2) consists of a board or plate, A, carrying terminals, F, T^2, O, T, S, C, and supporting a vertical board or plate, B, upon which are mounted two electro-magnets, M, and M^1, for operating the swinging frame, N; this frame is suspended at n, and carries the double screen, N^1, which allows the alternate closing of the red light shown by the disc, P, and the white light shown by the disc, P^1. These lights are produced by lamps such as that shown at Q^1, placed before reflectors, q^1, by which such lights are reflected. The whole of this signalling apparatus is inclosed in a box, R, provided in front with sight-holes for the disc, P and P^1, and also with chimneys for the lamps, Q^1. The impulse to the swinging frame for causing the same by changing its position to uncover the red or white light is imparted by the impact of the pallet or armature, v^1 or v^2, of the electro-magnet upon the end, n^2 or n^3, of the arm of the swinging frame when either of the pallets is under the influence of a current, the pallet then being suddenly attracted towards the magnet. Thus when the parts are in the position shown in the figure, and a current passes through the electro-magnet, M, the pallet, v^1, being suddenly attracted, will, by its end, v^3, strike the end, n^2, of the swinging frame, which will be brought into such a position as to cover the red light and uncover the white light—that is to say, the apparatus will be set to indicate "line clear." In this position the swinging frame will be engaged by the upper arm, v^2, of the pallet, v^2, of the electro-magnet, M^1, in the same manner as it was engaged by the upper end, v^1, of the pallet, v^1, of the electro-magnet, M, by which end the frame was released before the impulse causing it to change its position was imparted to the lower end thereof. When a current is passing through the electro-magnet, M, and the swinging frame is in the position shown in the drawing, the pallet has no effect upon the swinging frame; but the current at the moment the pallet comes in contact with the soft iron core of the electro-magnet passes through the said pallet, the upper part of which by means of the small springs, r, is brought in electrical contact with the terminal, r^2, which communicates with the earth-wire. This current in passing actuates the bell, which ceases

to operate at the moment of contact of the springs, r or r^1, with terminal, r^2 or r^3, and the pallet is returned to its vertical position by the action of a small spiral spring. The operation of this apparatus is as follows:—A current arriving through the terminal, F, passes through the electro-magnet, M^1, to the terminals, C and C^1, and to the bell at V. A current arriving by the terminal, O, passes through the electro-magnet, M, thence to the terminal, C (through the branch at c), and thence to the terminal, C^1, of the bell, V. Finally, a current passing through the terminal, T, connected with the earth passes through the branch, t, and the terminal, T^2, or through the terminals, r^2 and r^3, thence to the terminal, S, and subsequently to the terminal, T^1, of the bell, V. Thus a current arriving at F in the switch, M^2, serves to set the signals to indicate "train on line," at the same time ringing the bell, or the current serves only to ring the bell when the signals are already set to this position. A current arriving at O, in the switch, M^2, causes the apparatus to indicate "line clear," and actuates the bell at V; the earth wire of the line serves to establish communication with the springs which form the end or upper extremity of the pallets and causes the bell to operate. The pusher-switch, N^2 (figs. 3 and 4), consists of a wooden socket furnished with a cover carrying a pushing-stud or button provided with a spring, and when pressure is exerted upon the said button the extremity of a contact piece, a (which in its normal position is always in contact with the contact piece, a^1), is put in contact with the end of another contact piece, a^2, which is connected with the terminal, S; the latter is connected with the terminal, T^2, and the signalling apparatus. The contact piece, a, is connected with the line-wire by the terminal, L, and the contact piece, a^1, is connected with the terminal, R, in such manner that ordinarily the terminals, L and R, are connected, and the terminal, S, is ordinarily insulated. When contact of the two contact pieces, a and a^2, is caused by depressing the stud of the pusher-switch at one station, the "up" station for instance, and the terminals, S and L, are thereby connected, the current passing from the terminal, T^2, through the terminal, S, will actuate the bell at the other station (in this case the "down" station), and the line will be made clear for or blocked against the same as may be required. The two-way switch, M^2 (figs. 5 and 6), consists of a wooden socket having two terminals, F, O, and a central terminal, U, in connection with the terminal, R, upon the pusher switch, N^2. Upon the central terminal is mounted a switch crank or manipulator, u^1, which serves to direct the current, arriving from the line through the terminal, R, to the terminals, F or O, connected with corresponding terminals upon the signalling apparatus, X. Ordinarily the switch-crank, u^1, connects the central terminal, U, with the terminal, F, and the handle of the switch is held in the side of a cover hinged at m to the said socket, and secured by a padlock or other device on the opposite side, so that this switch cannot be directed to the terminal, O, unless the cover be unlocked, in which case the said cover can be opened and the switch-crank may be turned around the axis of the central terminal. When, therefore, the attendant at one of the stations, say, the "up" station, requires to have the line clear, he depresses the button of the pusher-switch, N^2, so as to operate the bell at the other station, as above stated. The attendant at the latter answers by depressing the







button of the switch, N², at the "down" station. The current coming from the line passes through the terminals, L and R (the terminal, S, being disconnected), goes from there to the central terminal, U, of the switch, M², passes through the terminal, F, thereof to a terminal of the signalling apparatus, X, and actuates the bell of the "up" station, as hereinbefore explained, then the attendant at this station opens the cover of his switch, M², places the switch-crank upon the contact piece, O, and presses twice upon the button of the switch, N², to inform the "down" station by two rings of the bell that the "up" station is in readiness to have its signal opened. The attendant at the "down" station by pressing upon the switch stud sends the current, which passing through the contact piece, O, of the "up" station actuates the signalling apparatus. When the train is sent off, the attendant at the "up" station closes the cover of the commutator, M², at the station after having put the switch crank in contact with the piece, F, and three times depresses the button of the switch, N². The attendant at the "down" station answers by pressing again upon the button of the switch, N², at this station, and the current then passing through the terminal, F, of the switch, M², sets the signalling apparatus to indicate that the line is blocked against the "up" station. A similar operation will take place when the attendant at the "down" station requires the line to be cleared, the direction being, however, reversed; it will be observed that the attendant at the station from which a train is to be sent must indicate that this may be done by simply depressing the button of the pusher-switch, N², at the station; the attendant at the station requiring to send the train cannot set his signals to indicate that the line is clear, nor receive the signal to that effect before having had the answer from the other station, and before having properly set the switch, M². As in some cases it may be inconvenient to light the lamps of the apparatus in the evening, in that case, as illustrated in the diagram, fig. 7, the apparatus may have a double arrangement with two red glasses. In daytime four discs will be seen simultaneously, but it will be understood that the line is clear when like colours are seen in the same vertical line, otherwise the line will be blocked.

4265. "Dynamo-electric machines." W. R. LAKE. (A communication from abroad by C. A. Hussey and Amzi Smith Dodd, of New York.) Dated October 19. 6d. Figure 1 is a side view partly in section of the

FIG. I.

new machine. A represents the magnet, which consists of a circular bar of cast iron, round in transverse section; B, B represent transverse projections from the magnet, A, which projections project inwardly and radially therefrom; C, C, designate arc-shaped extensions from the inner ends of the said projections, which extensions are concentric with the magnet, A. The wire is wound on the magnet, A, to an extent sufficient to make it on the inner side of the magnet form a continuation of the circle of which the extensions, C, are arcs, so that the armature before the poles or consequent points will rotate before the whole length of the magnet and wire wound thereon, and hence through the whole field of force all at the same time, whereby the effectiveness of the machine is greatly increased. F represents an armature comprising radial projections, *b*, and intervening spaces, *c*, in which the wire wound between the said projections is contained. The said armature is of a skeleton-like construction, consisting of a series of arcs of a circle, another series of arcs of a larger but concentric circle arranged opposite the spaces between the arcs first named, and a number of approximately radial portions connecting the two series of arcs. It has an opening from end to end through the centre, and likewise has openings from end to end through the radial projections.

4191. "Electric lamps." G. P. HARDING. Dated October 15. 6d. Figure 1 is a front elevation, and figure 2, a side elevation of the lamp. *a* represents the derivation coils taking portion of current from main

FIG 1

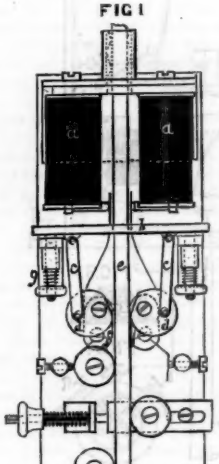
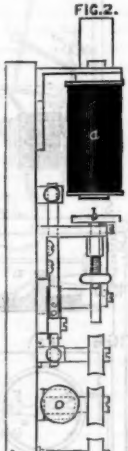


FIG.2.

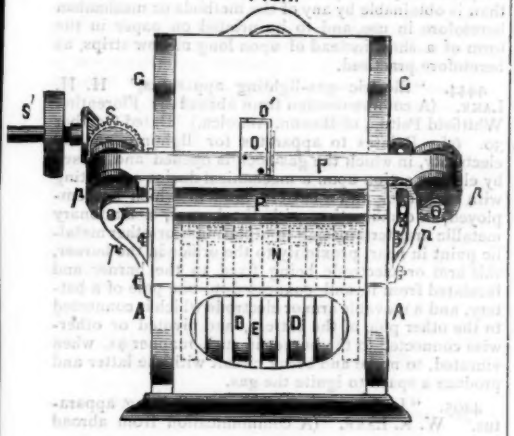


circuit. *b* the armature acting on the levers, *c*, *c*, and through them on the cams, *d*, *d*, which grip the carbon, *e*; *f* the cock on which the cams, *d*, swing. Assuming the lamp to be at rest, and the carbon, *e*, not resting on the lower carbon (not shown), directly connection is made from the machine to the lamp a portion of the current goes through the magnets, *a*, (*a*, being the route of least resistance, the armature, *b*, is attracted, and actuates the cams, *d*, which open and release the pressure on the carbon; the current now

passing between the two carbons the magnets become inactive, and the springs, *g*, *g*, pull back the armature and actuate the cams in the contrary direction, causing them to close and lift the carbon a short distance and establish the arc.

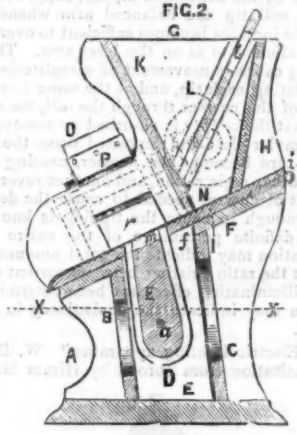
4310. "Apparatus for separating particles of iron from grain." W. R. LAKE, of the firm of Haseltine, Lake & Co., Patent Agents, Southampton Buildings, London. (A communication from abroad by S. Howes, N. Babcock, and C. Ewell, of New York.) Dated October 22. 6d. Relates to that class of magnetic separators which are employed for separating from grain, previous to grinding the same, any fragments of wire or other pieces of iron which may be mixed with it. The objects of the said invention are to so construct the separator that the particles of iron which are arrested by the operation of the magnets will be automatically removed from the surface on which they lodge, and that the magnets can be readily inserted within or removed from the compartment in which they are arranged. Figure 1 is a front elevation and figure 2

FIG. 1.



a longitudinal section of the machine. A, A represent the side walls, B the front wall, and C the rear wall of the compartment or chamber in which are arranged a series of horse-shoe magnets, D. The latter are bent in a plane at right angles to the width of the bar of which each magnet is formed; blocks of wood are arranged between the magnets, secured by a tie-rod, *e*. The blocks are shaped to fit snugly in the compartment formed by the walls, A, B, C, so that when they are placed in the same the magnets will be held in place without requiring any other fastening; F represents the top plate of the compartment in which the magnets are arranged. This plate is arranged in an inclined position at an angle at which the grain intended to be freed from the accompanying iron will run. The said plate, F, is provided with an opening, *f*, through which the ends of the magnets, D, project, and which is made of the same size as the compartment in which the magnets are arranged; G, G represent the side walls of the upper part of the frame of the machine; H is the rear cross plate, and I the bottom plate of this part of the frame. The upper part of the frame is connected with the lower part of the frame by a hinge, *i*, which permits the upper part to be swung back, whereby the opening, *f*, is exposed, so that access may be had through the said opening to the compartment in which the magnets are arranged for the insertion or removal of the same; K represents the feed-hopper arranged between the side walls, G, over the upper part of the plate, I, and provided with a plate, L, whereby the flow of grain from the hopper is regulated. An overflow aperture, *l*, is made in this plate, L, for the purpose of always maintaining a supply of material in the hopper. The bottom plate, I, of the upper part of the machine rests upon the top plate, F, of the lower part of the machine, and is inclined at the same angle as that of the top plate, F, of the lower part. The said plate, I, is provided with an opening, *m*, into which the poles of the magnets project; N is a plate of zinc secured to the upper side of the plate, I, and extending from the rear plate, H, downward to the edge of the plate, I; O is a wiper or scraper whereby the particles of iron which adhere to the plate, N, are removed from the latter. This wiper, O, traverses the said plate, N, in one direction only, and is attached to an endless belt, P, which passes over two pulleys, *p*, arranged on the outer side of the side walls, G, and supported in suitable bearings, p^1, which are secured to

FIG. 2.



the outer side of the walls, G. The bearings of one of these pulleys are made adjustable in line with the belt by means of a screw bolt and nut, *q*, whereby the tension of the belt can be regulated. This wiper, O, is composed of an angular piece having a tight top plate, O^1, which prevents the grain from entering the space below the plate, O^1, when the wiper traverses the zinc plate, N. The upper part of the belt, P, passes over the plates, G, and the lower part of the belt passes through openings, *r*, which are formed in the side plates, G, and which are made large enough to permit the wiper to pass through the same. Motion is imparted to the belt by means of gear-wheels, S, and a pulley, S^1. The grain to be treated is conveyed into the hopper, K, from which it flows upon and over the zinc plate, N, and is discharged over the lower edge of the latter. The particles of iron which are mixed with the grain are subjected to the attraction of the magnets exerted through the zinc plate, N, and are thereby arrested and held on this plate while the grain passes on. At certain intervals according to the speed of the belt, the wiper, O, traverses the plate, N, and gathers the particles of iron which have lodged on the same, and moves them to one side of the plate, where they are discharged through the opening, *r*, into any suitable receptacle. The plate, O^1, at the head of the wiper, O, prevents the

grain from coming in contact with that side of the wiper against which the particles of iron accumulate as they are moved over the plate, N, and it thereby prevents any grain from becoming mingled with the iron. The frame of this wiper is made entirely or partially of magnetic material, so that in passing over the conveying surface, it will be drawn down thereon by magnetic attraction, and its edges are faced with strips of india-rubber or similar material.

4391. "Measuring the amount of electrical current flowing through a circuit." P. JENSEN. (A communication from abroad by Thomas Alva Edison, of America.) Dated October 27. 6d. A depositing cell is used in which plates are suspended but insulated from a balanced arm, to which is attached a lever arm, on which is a weight adjustable on a lever arm, so that the amount of excess of weight upon one plate over the other required to cause a tilting of the balanced arm may be determined and regulated. The cell so arranged is placed in a branch circuit, so that a definite fraction of the current used shall traverse the branch circuit and depositing cell. As the weight of one plate is increased by the deposition of, say, copper from the solution, it will tip the balanced arm whenever the weight of the increase becomes sufficient to overbalance the weight alluded to as on the lever arm. The lever arm moving causes a movement of a registering apparatus registering each tip, and at the same time causes a reversal of the current through the cell, the effect of which is that the copper is absorbed or removed from the now heavier plate and deposited upon the lighter, until it in turn becomes the heavier, causing another tipping, another registration, and another reversal. As the amount of current needed to cause the deposition of metal enough to cause the tipping is known, and as it is a definite percentage of the entire current, the registration may indicate the total amount of current; or as the ratio existing between current and feet of gas for illuminating effect has been determined, the registration may indicate the equivalency in light of feet of gas.

4393. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by Hiram Maxim, of

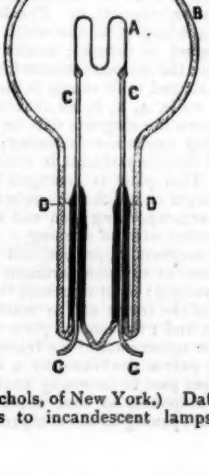
New York.) Dated October 27. 6d. Relates to incandescent lamps in which means are provided for the easy removal and replacement of the carbon slip when required. The lamp has a stopper with a rim or lip, *e*, turned up about the edge of the neck of the globe, and the neck is joined to this lip by means of a ground joint. The lip flares out slightly above the joint so as to form a trough for the reception of gum or other sealing material, and is recurved, as shown, so that the material used will not run out when the lamp is inverted.

4428. "Electric lamps." J. H. JOHNSON. (A communication from abroad by Albert Berjot, of Paris.) Dated October 29. 4d. Relates to electric lamps, and it consists chiefly in the employment of a regulating apparatus arranged in the form of a parallelogram with flexible spring joints in combination with a number of pairs of carbons which are consumed in succession, the current being automatically diverted into a fresh pair when the pair in use for the time being has been consumed. (*Provisional only.*)

4434. "Telegraphic recording apparatus." T. M. FOOTE, of New York. Dated October 30. Relates to improved mechanism for recording in a legible manner despatches, messages, or other communications transmitted by means of electricity, and consists in various improvements for causing the letters, figures, or other characters forming the message or communication to be printed upon a piece of paper in a better manner than is obtainable by any of the methods or mechanism heretofore in use, and to be printed on paper in the form of a sheet instead of upon long narrow strips, as heretofore practised.

4444. "Electric gas-lighting apparatus," H. H. LAKE. (A communication from abroad by Florentine Whitfield Pelton, of Boston, America.) Dated October 30. 6d. Relates to apparatus for lighting gas by electricity, in which the gas-cock is opened and closed by electric action upon a mechanical device connecting with such cock and a battery, and in which are employed, in combination with the burner, a stationary metallic arm terminating in a platinum or other metallic point in near proximity to the orifice in the burner, this arm or electrode being fixed to the burner and insulated from it, and connected to one pole of a battery, and a movable arm or electrode which is connected to the other pole of the battery, and pivoted or otherwise connected to the burner in such manner as, when vibrated, to make and break circuit with the latter and produce a spark to ignite the gas.

4495. "Improvements in electric-lighting apparatus." W. R. LAKE. (A communication from abroad



by Joseph V. Nichols, of New York.) Dated November 3. 6d. Relates to incandescent lamps. A is the

incandescent conductor; B is the glass globe inclosing the conductor; C, C are conducting wires of copper; D, D are tubes made of cement (composed by thoroughly mixing and fusing together fifty-eight parts by weight of oxide of lead, seventeen parts of silica, ten parts of oxide of iron, ten parts of oxide of copper, and five parts of potash or soda), fused and sealed to the conducting wires at their upper ends and to the glass of the globe at their lower ends, so that the base of the globe is hermetically sealed about the said conducting wires. The tube of cement is joined to the wire when both are at a white heat, so as to remove all oxide from the surface of the metal and insure perfect adhesion between the parts. By way of additional precaution a second joint is made between the tube and the wire, a short distance below the upper end of the tube. The air is exhausted from the globe in the usual way, so as to leave as perfect a vacuum as practicable.

4515. "Electrical mouthpieces." JAMES DUNBAR. Dated November 4. 2d. Relates to improvements in drinking vessels, for imparting electric currents to fluids whilst passing into the mouth. One or more opposite metals (or negative and positive metals) are used in conjunction with any insulating medium, in connection with the rims of drinking vessels, tubes, or mouthpieces of any description, whereby an electric current is obtained in the liquid or moist fluid as it passes over the said metals, or negative and positive poles, into the mouth, and also sometimes a current in the mouth. (*Provisional only.*)

4621. "Magneto-electric signal apparatus." E. G. BREWER. (A communication from abroad by E. H. Johnson and T. A. Edison, of America.) Dated November 10. 6d. Relates to an attachment to magneto-electric machines by which the latter can be cut out of circuit when not in use, being thrown into circuit only when in use.

Proceedings of Societies.

PHYSICAL SOCIETY.—JUNE 11th.

Lord RAYLEIGH in the Chair.

New Members—Mr. J. E. H. Gordon and Mr. J. E. Stead, E.I.C.

Professor FLEMING exhibited a new form of B.A. Unit Resistance Coil, devised by him for experiments in the Cavendish laboratory, with a view to obviate the leakage in the older form due to condensed moisture on the paraffin insulating the electrodes, and also to facilitate the equalisation of the temperature of the coil with the medium it is placed in. For this purpose the wire is wound bare, each layer being insulated from the rest by ebonite fenders niched to receive turns, and the coil is inclosed in a brass box, screwed together. This box is watertight and may be soldered or provided with an india-rubber washer between the two flanged halves which screw together.

Dr. STONE said he usually insulated the B.A. coil when plunging it in water by putting it in a beaker of paraffin oil which was immersed in turn in the water.

Professor AYRTON pointed out the advisability of makers aiming rather at turning out exact resistances of any definite value than wasting time and increasing the cost of the coils by adjusting them to a given figure, such as one or ten ohms.

Professor W. CHANDLER ROBERTS read a paper on the hardening and tempering of steel. He pointed out that few questions connected with the metallurgy of iron or steel are attracting more attention now than the relation between a metal and the gases it comes into contact with during manufacture. The carbonisation of iron has long been of great interest, as shown by the work of Clouet at the end of last century, and that of Margueritte in 1865, who showed that though the conversion of iron into steel could be effected by contact with carbon, even in the diamond form, it is nevertheless true that in the ordinary process carbonic acid plays a considerable part, which had been overlooked. Graham's 1867 paper on the occlusion of gases by metals gave point to Margueritte's work by showing that carbonic oxide can penetrate to the centre of a mass of iron. It is introduced, in fact, at a comparatively low temperature, while a high temperature is necessary to enable the metal to appropriate the carbon and become steel. Metallurgists are now carefully investigating the effect of occluded gases in iron and steel.

Professor ROBERTS considered the point recently raised as to whether the hardening and tempering of steel might not be influenced by the occlusion or expulsion of gas. He described experiments by which he proves that as steel hardens when rapidly cooled *in vacuo*, gases could not play any part in the tempering. He also dwelt on the precautions necessary to keep the metal in the experiment free from occluded gas. He then showed that Bergman (to whom we owe our knowledge that the difference between wrought iron and steel depends on the carbon in the latter) showed, in 1781, that fixed air could give up its carbon to iron; and he concluded by showing that Reaumur, so long ago as 1722, actually employed the Toricellian vacuum in experiments on the tempering of metal, the metal being placed red-hot in a highly rarefied atmosphere. Reaumur also had a clear view of the effect a gas might have on the physical properties of a metal, a point of great interest to physicists in general.

Professor HUGHES expressed the opinion that temper was not due to absorption of hydrogen, but to the absorption of carbon in the iron.

Mr. STROH found that an electrically fused steel contact was glass-hard.

Professor GUTHRIE exhibited a steel chain which he had beautifully blackened by dipping in fused nitre. The skin might be useful in the arts, and was, perhaps, analogous to that produced by Barff's process.

Lord RAYLEIGH, Mr. WALENN, Mr. LECKY, Dr. COFFIN, Professor AYRTON, and others, continued the discussion.

Mr. GRANT then read a paper on curves of electromagnetic induction, which he had traced out by means of primary and secondary coils sliding on frames, so as to take different positions with respect to one another. The paper was illustrated by experiments and diagrams.

Professor REINOLD then read portions of a paper by Professor S. P. Thomson, on the opacity of tourmaline crystals. The optical and electric properties of these crystals are related, and Professor Thomson propounds an explanation of this connection based on the late Clerk-Maxwell's electro-magnetic theory of light. The full paper will be published in the *Journal* of the Society.

JUNE 25TH.

Professor FULLER in the chair.

Sr. OLYMPIO DE BARCELOS elected a member.

Mr. GRANT exhibited an apparatus for showing the position and direction of the curve of zero electrodynamic induction. It consisted of two coils of insu-

lated wire mounted on stands, one being fixed, while the other was free to revolve round it at a fixed distance.

Prof. W. E. AYRTON explained the determination of the refractive index of ebonite made by himself and Prof. Perry. The result for oxyhydrogen light was 1·7; but at the suggestion of Prof. Fitzgerald, of Dublin, this was checked by measuring the polarising angle of ebonite by reflected light. Sunlight was employed in these experiments, and different pieces of ebonite. The result was 1·611. Professors Ayrton and Perry had repeated their former experiments, using the electric light and a battery of 70 volts E. M. F. The result confirmed the one first obtained. They had also determined the index of refraction in the ordinary way from the red rays which they observed to pass through the prism of ebonite. Result for the least refrangible rays, 1·66.

Mr. BOYS remarked that one could see better through thin ebonite if it was varnished or wetted than when untreated.

A letter was read by the CHAIRMAN from a sub-committee of the British Association, inviting the members of the Society to send exhibits to the jubilee meeting of the B. A. at York.

Dr. JAMES MOSER read a paper on the microphonic action of selenium cells, in which he argued that the action of the selenium cell in the photophone was that of a microphonic contact or bad joint between the metal electrodes or metal plates of the cell and the selenium. The heat rays of the photophonic beam caused the joint to expand and contract; hence the variation in the current passing through the receiving telephone. Dr. Moser also exhibited a piece of selenium which increased, not diminished, in electric resistance when light fell upon it. He further showed a standard Daniell cell of the gravity type, which consisted of a glass vessel containing the copper plate at the bottom, immersed in sulphate of copper solution, and the zinc plate at the top, immersed in sulphate of zinc solution; and a clear line of demarcation between these solutions was produced by suspending an independent piece of zinc midway between the plates, so as to decompose all the sulphate of copper which diffused upward to that point.

Prof. MACLEOD said that he had produced the same result by surrounding the zinc plate with a cage of copper wire connected to the copper plate. Copper deposited on the cage and the cell was in constant use. Dr. Lodge said that arrangement would not, however, serve as a standard of electromotive force, because all the copper-plate should be in the copper solution. In his cell the copper and solution are both in a test tube, immersed in the zinc solution, and diffusion has to take place up this test tube and down the cell, so as to enter a second tube open at the bottom in which the zinc is placed.

Dr. GUTHRIE showed a new experiment to the effect that where a magnet is suspended over a disc of copper and the disc is rotated, the magnet is repelled upwards. The experiment was shown by suspending a horse-shoe magnet from one end of a scale beam counter-weighted. As a possible explanation, he suggested that the vertically resolved force of the induction current before the magnet might be greater than than that behind the magnet.

The SECRETARY read a paper by Professor Balfour Stewart and Mr. W. Strode, on results obtained by a modification of Bunsen's calorimeter, described to the Society in January last year. With a new instrument made by Casella they have determined the mean specific heat of iron to be 0·1118, and that of sulphur 0·1 756—the true values being given as 0·1138 and 0·1776. The advantage of the method is its simplicity and the fact that very small quantities of the substance may be used.

Dr. LODGE then explained experiments by Mr. Sutherland, showing that a Daniell cell keeps its E.M.F. very constant when heated, because the thermo-electric effect at the junction of the zinc with the solution is balanced by that at the junction of the copper with the solution.

After remarks by Dr. MOSER and Professor PERRY, the Society separated until November next.

THE announcement is made in New York that a contract was signed on May 25th between General Grant, on behalf of the International Ocean Telegraph Company, and the Mexican Government, for a new cable between the United States and the West Indies, Mexico, and Central America, by way of Cuba and Yucatan, the work to begin immediately.

THE telegraph steamer *Faraday* arrived off Land's End on the morning of the 28th ult. and picked up the buoyed end of the new American Cable, after which she proceeded to pay out.

A NEW YORK telegram of the 27th ult. says:—The duplicate telegraphic cable from Key West to Havana has now been completed.

The following are the final quotations of stocks and shares for the 29th ult.:—Anglo-American, Limited, 53-54; Ditto, Preferred, 84-85; Ditto, Deferred, 24½-25½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10¼-10¾; Brush Light, ——; Electric Light, —— Consolidated Telephone Construction, ——; Cuba, Limited, 9¼-9½; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 4½-5; Direct Spanish, 10 per cent. Preference, 13¼-14½; Direct United States Cable, Limited, 1877, 10¼-10¾; Debentures, 1884, 103-105; Eastern Limited, 10¼-10¾; Eastern 6 per cent. Preference, 12¼-13¼; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 103-106; Eastern, 5 per cent., repayable Aug., 1899, 106-109; Eastern Extension, Australasian and China, Limited, 11¼-11½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 106-109; Ditto, registered, repayable 1900, 106-109; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 106-109; Ditto, ditto, to bearer, 105-108; German Union Telegraph and Trust, 11¼-11½; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12¼-12½; Great Northern, 13¼-13½; 5 per cent. Debentures, 103-107; India Rubber Company, 20¼-21¼; Ditto, 6 per cent. Debenture, 107-110; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5¾-6¼; Mediterranean Extension, Limited, 2¾-3; Mediterranean Extension, 8 per cent. Preference, 9¼-9½; Oriental Telephone, ⅞-¼; Reuter's Limited, 11-12; Submarine, 280-290; Submarine Scrip, 2¾-3; Submarine Cables Trust, 103-106; United Telephone, ——; West Coast of America, Limited, 4¼-5; West India and Panama, Limited, 2-2½; Ditto, 6 per cent. First Preference, 7¼-8; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 8¾-9; Ditto, 6 per cent. Debentures "A," 108-110; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 32-32½; Ditto, 6 per cent. Bonds, 106-110; Ditto, Second Bonus Trust Certificates, 3¾-4¼.